12th Annual National Health Outcomes Conference 2006: Managing Health and Disease in Today's Society. Canberra 9-10 August 2006. (Peer-Reviewed Paper)

Assessing the Concordance of Coded Morbidity and Mortality Data for In-Hospital Trauma-Related Deaths.

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Abstract

To examine the effectiveness of trauma systems, in-hospital mortality rates are key indicators. However, to date there has been little research examining the congruence of morbidity and mortality data as recorded in hospital databases and mortality databases.

A retrospective review of coded medical records from a trauma registry, a metropolitan teaching hospital and the National Death Index for 1747 patients admitted to hospital for ≥ 24 hours for acute treatment of injury was undertaken. This study was established to determine the number and cause of differences in coded data between hospital records and National Death Index (NDI) records for in-hospital deaths following admission for trauma. Of the 60 patients who died in hospital, 26% died from non-traumatic causes according to NDI coded data. Over half of the cases with trauma coded in the NDI contained external cause data which were less specific or did not match external cause data from hospital records.

When reviewing trauma-related outcomes, where possible injury researchers and policy advisors should consider both mortality and morbidity datasets when reviewing in-hospital deaths, as this research identified that the morbidity dataset provides greater detail for injury and external causes of injury than mortality coded data for in-hospital deaths.

Introduction

To examine the effectiveness of trauma systems, in-hospital mortality rates of patients admitted for trauma are key indicators. Deaths in this group of patients may be due to the injury/ies that caused the hospitalisation, or alternatively may be due to other unrelated causes. While in-hospital mortality rates are widely reported, few authors have investigated the concordance of causes of death and causes of hospital admission of trauma patients. In a three year sample of more than 90,000 patients admitted to all acute care hospitals in the state of Washington, USA, a 2.1% mortality rate was reported, with 57% of these deaths being due to trauma and the remaining 43% of deaths predominantly due to cardiovascular disease or cancer (1).

When reviewing causes of death it is important to consider the source of the information and the potential for differences between morbidity compared to mortality coding. Previous research has suggested that diagnostic issues, certification processes and coding error contribute to discrepancies between morbidity and mortality data sources (2, 3). Factors that may lead to inconsistencies in morbidity and mortality coded data include 1) different coding guidelines and selection rules, 2) differences in the classification versions used, 3) coding errors, 4) documentation differences, and 5) autopsy and certification processes.

Different Guidelines and Rules for Morbidity and Mortality Coders

In Australia, the guidelines and processes for morbidity and mortality coding differ, with morbidity coding largely undertaken at hospitals and mortality coding centralised at the Australian Bureau of Statistics. Morbidity coders code either manually from coding books or use encoder software while the mortality coding process is a largely automated practice, with Mortality Medical Data System (MMDS) software assigning causes of death information from the death certificate (4). Rules used to select the codes for causes of death or morbidity diagnoses differ in the two processes. In morbidity coding, coders select the principal diagnosis considered to be *chiefly responsible for occasioning the patient's episode of care in hospital*, and code other relevant condition/s if they are considered to coexist with the principal diagnosis and affect patient management or arise *during the episode of care* (5). In mortality coding, the underlying cause of death (UCOD) is the condition, event or circumstances without which the patient would not have died (6). In the case of deaths due to accidents or trauma, it is usual to code the external cause resulting in the injury as the UCOD. All other conditions, including the injuries resulting from the external cause, are coded as multiple causes of death (MCOD).

Differences in the Coding Version

In Australia, there are differences in the version of the classification used by morbidity and mortality coders, with morbidity coders currently using the ICD-10-AM (though at the time of this study the coding version in use was the ICD-9-CM) and mortality coders using the ICD-10 (Slide 6). Comparisons between the data coded using the two classifications or mapping between them is possible because the classifications are largely the same at the core code level, although data coded using the ICD-10-AM, with its greater detail, may be more useful for trauma research purposes.

Coding Errors

A number of registries and hospitals have attempted to demonstrate concordance between data recorded by multiple services within a hospital or between data recorded by a hospital and that of national facilities, such as death registries (7, 8). Incomplete and inaccurate coding has been reported previously in both injury coding (9, 10) and other health care fields (11, 12), with error rates as high as 28% being reported.

Documentation Differences

While morbidity coders have a complete hospital record to use in the coding of diagnoses and procedures, mortality coders are largely confined to the death certificate in their coding of underlying and contributory causes of death. Previous research has found that the correlation between hospital records and death certificates varies depending on the principal diagnosis, type and number of co-morbidities of the patient, time from admission to death, acuity of the condition, and the details available regarding the diagnoses (2, 3, 13).

Autopsy and Certification Processes

Autopsy and certification processes affect the concordance of morbidity and mortality data. The clinician certifying the death or the coroner conducting the autopsy and investigation may be unaware of the presence of an injury, or not consider the injury to be a contributory factor towards the death, and therefore may not document the injury and corresponding external cause on the death certificate (2). Similarly, hospital staff may be unaware of the circumstances of trauma or presence of an injury or disease and therefore not adequately document the diagnosis or external cause in the medical record.

Autopsy results may not have been available at the time of coding of the hospital record, limiting the amount of detail coded from that source. Equally, because of the slowness of the coronial systems in some jurisdictions, it is sometimes necessary for the ABS to code deaths for the NDI prior to final release of coronial findings potentially resulting in the use of unspecified codes as opposed to more defined diagnoses and/or external causes.

Objectives

This study was established to determine the rate and cause of in-hospital deaths of trauma patients, as well as to determine the number and type of differences in coded data between hospital and National Death Index records. The specific research questions reported in this paper included:

- What was the in-hospital mortality rate for patients admitted to hospital for trauma?
- Was trauma recorded on the death certificate of patients who died in hospital?
- If trauma was recorded, was there concordance in the coded data between the morbidity and mortality collections for trauma patients who died in hospital?

Method

Participants and Procedure

This study used data-linkage and health classification methodologies to match and compare documentation from three sources: a trauma registry, a major metropolitan teaching hospital, and the National Death Index (NDI). Participants included 1672 patients registered in the trauma registry in 1998 who were admitted to hospital for 24 hours or more following an injury. Of the 1672 trauma presentations, 60 (3.6%) cases died during the hospital admission, and these cases form the sample for this study. Approval from University, Hospital, and Australian Institute of Health and Welfare human research ethics committees were obtained prior to undertaking this research.

Data Linkage Methodology

Trauma registry records were matched to hospital records to obtain admission and discharge details and coded diagnoses for all cases in the sample (For more detail of the concordance of hospital records and trauma registry records see McKenzie et al (2005) (14)). Demographic variables including name, sex, date of birth and available dates of death were selected from the trauma registry's 1998 data, and provided to the Australian Institute of Health and Welfare (AIHW) for matching purposes. The Australian NDI provides mortality information for all deaths occurring in Australia since 1980 for the purposes of epidemiological research (15). The NDI includes UCOD for all data years and MCOD information for deaths occurring since 1997. Data are matched using probabilistic matching and research examining the accuracy of NDI matches has reported specificity of 98.5% and sensitivity of 89.2% (16).

Comparison of Data Sources

For all hospital deaths, a more detailed examination of the relatedness between codes from the original sources was undertaken. NDI matched cases were categorised as 1) dying from a medical condition with no trauma recorded on the death certificate, 2) dying from a medical condition with trauma recorded as a MCOD or 3) dying from trauma with an external cause as the UCOD. For cases with trauma as an UCOD or MCOD, an expert coder compared all morbidity codes with all mortality codes for each case and allocated a rank to identify whether any external cause codes were the same, used more defined codes in the NDI than the hospital records, used less defined codes in the NDI than the hospital records, or did not match. By less defined codes, we refer to the use of 'dump' codes or non-specific codes, which provide limited information about the specific cause of the injury, such as the code X59 'Exposure to Unspecified Factor'.

Results

Principal Diagnoses by Medical/Traumatic Cause of Death

Deceased patients were classified as dying from a medical condition with no trauma coded, dying from a medical condition with trauma as a MCOD, or dying from trauma. Almost 90% (n=50) of the matched hospital deaths had trauma codes included in the NDI, however 18% (n=9) of these cases had an UCOD that was non-traumatic. In addition, 11% (n=6) did not have trauma coded anywhere in the NDI, and 4 cases did not have cause of death data available in the NDI (only fact of death recorded in NDI). Table 1 shows the main cause of injury resulting in hospitalisation by cause of death (See Table 1 and Slide 14).

Table 1: Cause of Hospitalised Injury by Cause of Death

Cause of Hospitalised Injury	Medical UCOD No Trauma		Medical UCOD Trauma MCOD		Trauma as UCOD	
	n	%	n	%	n	%
Motor vehicle traffic accidents	1	6.7	1	6.7	13	86.7
Other transport accidents	0	0	0	0	1	100
Accidental falls	4	19.0	8	38.1	9	42.9
Accidents caused by fire and flames	0	0	0	0	6	100
Accidents caused by machinery	0	0	0	0	1	100
All other accidents, incl. late effects	0	0	0	0	1	100
Suicide and self- inflicted injury	1	14.3	0	0	6	85.7
Homicide	0	0	0	0	3	100
Other external causes	0	0	0	0	1	100
TOTAL	6	10.7	9	16.1	41	73.2

Missing n=4 (COD unknown)

Causes of injury by medical/traumatic cause of death differed between those who were less than 65 years of age and those who were 65 years of age or more, with almost all of deaths of individuals under 65 years of age coded with trauma as the UCOD, compared to only half of the deaths of individuals over 65 years of age (See Table 2.).

Table 2 Cause of Hospitalised Injury by Cause of Death across Age Groups

Cause of Hospitalised Injury	Age < 65				Age ≥ 65			
	Medical UCOD		Trauma UCOD		Medical UCOD		Trauma UCOD	
	n	%	n	%	n	%	n	%
Motor vehicle traffic accidents	0	0	10	100	2	40.0	3	60.0
Other transport accidents	0	0	1	100	0	0	0	0
Accidental falls	1	33.3	2	66.7	11	61.1	7	38.9
Accidents caused by fire and flames	0	0	3	100	0	0	3	100
Accidents caused by machinery	0	0	1	100	0	0	0	0
All other accidents, incl. late effects	0	0	1	100	0	0	0	0
Suicide and self- inflicted injury	0	0	6	100	1	100	0	0
Homicide	0	0	2	100	0	0	1	100
Other external causes	0	0	1	100	0	0	0	0
TOTAL	1	3.6	27	96.4	14	50.0	14	50.0

Missing n=4 (COD unknown)

Concordance of Cause of Injury Data for Trauma Deaths

For those cases where the UCOD was traumatic, the degree of concordance between the external cause coded by the hospital and the NDI was investigated. External causes of injuries were considered the same in 36% (n=18) of cases, more defined in the NDI than the hospital record in 14% (n=7) cases, less defined in the NDI than the hospital record in 22% (n=11) of cases, and the external cause did not match for 28% (n=14) cases (Slide 13). Table 3 shows the concordance of the main cause of injury resulting in hospitalisation with the NDI (See Table 3.).

Table 3: Concordance of Cause of Injury Data for Trauma Deaths

Cause of Hospitalised Injury	Match		NDI More Specific		NDI Less Specific		No Match	
	n	%	n	%	n	%	n	%
Motor vehicle traffic accidents	6	42.9	3	21.4	5	35.7	0	0
Other transport accidents	1	100	0	0	0	0	0	0
Accidental falls	4	23.5	0	0	0	0	13	76.5
Accidents caused by fire and flames	2	33.3	0	0	4	66.7	0	0
Accidents caused by machinery	0	0	0	0	1	100	0	0
All other accidents, incl. late effects	0	0	1	100	0	0	0	0
Suicide and self- inflicted injury	4	66.7	0	0	1	16.7	1	16.7
Homicide	1	33.3	2	66.7	0	0	0	0
Other external causes	0	0	1	100	0	0	0	0
TOTAL	18	36.0	7	14.0	11	22.0	14	28.0

Missing n=4 (COD unknown); 6 cases excluded with no trauma coded in NDI.

Concordance of morbidity and mortality data for external cause differed between those who were less than 65 years of age and those who were 65 years of age or more, with 67% of cases under 65 years of age having matching or more detailed information in the NDI compared to only 27% of cases aged over 65 years of age (See Table 4.).

Table 4 Degree of Concordance of Cause of Injury Data across Age Groups

Degree of Concordance	Age < 65		Age ≥ 65	
	n	%	n	%
ExC Match	13	46.4	5	22.7
ExC More Specific in NDI	6	21.4	1	4.5
ExC Less Specific in NDI	7	25.0	4	18.2
ExC No Match	2	7.1	12	54.5
TOTAL	28	100	22	100

Missing n=4 (COD unknown); 6 cases excluded with no trauma coded in NDI.

Discussion

Mortality Rate and Causes of Death for Trauma Patients

In this cohort of trauma cases the in-hospital mortality rate for patients admitted to hospital for 24 hours or more for the acute treatment of injury was 3.6%. This is consistent with similar cohorts of trauma patients where mortality rates of 4 – 7% have been reported (17-19). Higher mortality rates have been reported when specific sub-groups of patients such as older adults have been reviewed (19, 20).

Comparisons of Morbidity and Mortality Coding for Trauma Patients

Some of the differences in coded data between hospital records and the NDI can be explained by the different rules and guidelines for morbidity coding compared to mortality coding. As morbidity coders select the principal diagnosis as the condition mainly responsible for the episode of care, while mortality coders use the WHO selection rules for allocating an UCOD according to a sequence of events leading to the death, the principal diagnosis of the trauma patient may not in fact be considered to be the UCOD. This was evident for deaths of patients aged over 65 years of age, where half of the cases were coded with a medical UCOD as opposed to a traumatic UCOD. Older people are more likely to have other co-morbidities that complicate their trauma admission than younger people, which arguably increases their mortality risk (21-24).

Differences between coded morbidity and mortality data can also be attributed to documentation differences or unclear documentation provided on the death certificate. The majority of cases where the external cause was deemed to be less specific or did not match the NDI can be attributed to the use of dump categories, where more detailed hospital coded data is coded to an 'Unspecified' category in the NDI. More defined coding could have been utilised for the NDI if documentation, such as that available in the hospital record, was available for the death certificate coding process.

Recommendations

With over half of the external cause codes being more defined in morbidity coded data compared to mortality coded data, trauma researchers should consider using hospital morbidity data in conjunction with national mortality data to afford greater detail when researching causes of death in hospitalised trauma patients. Morbidity data, coded using ICD-10-AM can be mapped to mortality data coded using ICD-10, but does afford greater levels of detail, especially in relation to injury and external cause coding compared with ICD-10 coded data.

It is essential that researchers consider the aim of their research, and therefore the most appropriate source of coded data, prior to undertaking relevant studies. For example, a study intended to examine quality of care and resultant complications in trauma patients is likely to be more usefully conducted using hospital based or trauma registry data, while a study examining mortality rates across an entire population will only be able to be effectively conducted using National Death Index data. Whichever population of data is used, the underlying constraints inherent in its production need to be clearly understood.

This study was conducted using data from a single hospital and a single trauma registry. There is insufficient detail in this study to demonstrate whether the results can be generalised to other hospitals, or other trauma registries. Consequently, the study should be repeated in both multiple hospitals and other trauma registries to determine whether similar coding issues are identified in different locations and systems.

Conclusion

When reviewing trauma-related outcomes, where possible injury researchers and policy advisors should consider both mortality and morbidity datasets when reviewing in-hospital deaths, as this research identified that the morbidity dataset provide greater detail for injury and external causes of injury than mortality coded data for cases of in-hospital deaths.

References

1. Mullins RJ, Mann C, Brand DM, Lenfesty BS. Specifications for Calculation of Risk-adjusted Odds of Death Using Trauma Registry Data. Am J Surg 1997;173:422-425.
2. Goldacre MJ. Cause-specific mortality: understanding uncertain tips of the disease iceberg. J Epidemiol Community Health 1993;47:491-496.
3. Weeramanthri TS. A medical cause of death validation study of adult aboriginal deaths in the Northern Territory of Australia in 1992. Public Health 1997;111(6):429-33.
4. McKenzie K TS, Walker S, and Sadkowsky K. Evolution in classifying mortality statistics. Sydney: National Centre for Classification in Health; 2002.
5. National Centre of Classification in Health (NCCH). The International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM). Fourth Edition. Volume Five-Australian Coding Standards. Sydney: University of Sydney; 2004.
6. World Health Organization (WHO). International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10). Volume II. Geneva: WHO; 1994.
7. Johansson LA, Westerling R. Comparing hospital discharge records with death certificates: Can the differences be explained? J Epidemiol Community Health 2002;56:301-308.
8. Rawson NSB, Robson DL. Concordance on the Recording of Cancer in the Saskatchewan Cancer Agency Registry, Hospital Charts and Death Registrations. Can J Public Health 2000;91(5):390-393.
9. MacIntyre CR, Ackland MJ, Chandraraj EJ. Accuracy of injury coding in Victorian hospital morbidity data. Australian and New Zealand Journal of Public Health 1997;21(7):779 - 82.
10. Curtis K, Bollard L, Dickson C. Coding errors and the trauma patient - is nursing case management the solution? Australian Health Review 2002;25(4):73 - 80.
11. Ballaro A, Oliver S, Emberton M. Do we do what they say we do? Coding errors in urology. BJU Int 2000;85:389-391.
12. Austin PC, Daly P, Tu JV. A multicenter study of the coding accuracy of hospital discharge administrative data for patients admitted to cardiac care units in Ontario. Am Heart J 2002;144(2):290-296.
13. Goldacre MJ, Roberts SE, Yeates D. Mortality after admission to hospital with fractured neck of femur: Database study. Br Med J 2002;325:868-869.
14. McKenzie K, Walker S, Besenyei A, Aitken LM, B A. Assessing the Concordance of Trauma Registry Data and Hospital Records. Health Information Management 2005;34(1):3-7.
15. Australian Institute of Health and Welfare (AIHW). National Death Index [Online] 2002 [Accessed 25 Jan 2005]. Available:
16. http://www.aihw.gov.au/cancer/ndi/index.html
17. Kelman C. The Australian National Death Index: An assessment of accuracy. Aust N Z J Public Health 2000;24(2):201-203.
18. Demetriades D, Murray J, Charalambides K, Alo K, Velmahos G, Rhee P, et al. Trauma fatalities: time and location of hospital deaths. J Am Coll Surg 2004;198(1):20-6.
19. Gannon CJ, Napolitano LM, Pasquale M, Tracy JK, McCarter RJ. A statewide population-based study of gender differences in trauma: validation of a prior single-institution study. J Am Coll Surg 2002;195(1):11-8.
20. Hannan EL, Waller CH, Farrell LS, Rosati C. Elderly trauma inpatients in New York state: 1994-1998. J Trauma 2004;56(6):1297-304.
21. Richmond TS, Kauder D, Strumpf N, Meredith T. Characteristics and outcomes of serious traumatic injury in older adults. J Am Geriatr Soc 2002;50(2):215-22.
22. Meldon SW, Reilly M, Drew BL, Mancuso C, Fallon W. Trauma in the Very Elderly: A Community-Based Study of Outcomes at Trauma and Nontrauma Centres. J Trauma 2002;52(1):79-84.
23. Mullins RJ, Mann NC, Hedges JR, Worrall W, Helfand M, Zechnich AD, et al. Adequacy of hospital discharge status as a measure of outcome among injured patients. JAMA 1998;279(21):1727-31.
24. Olson CJ, Brand D, Mullins RJ, Harrahill M, Trunkey DD. Time to Death of Hospitalized Injured Patients as a Measure of Quality of Care. J Trauma 2003;55(1):45-52.
25. Boockvar KS, Halm EA, Litke A, Silberzweig SB, McLaughlin M, Penrod JD, et al. Hospital Readmissions After Hospital Discharge for Hip Fractures: Surgical and Nonsurgical Causes and Effect on Outcomes. J Am Geriatr Soc 2003;51(3):399-403.

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